

### REMARKS

This paper is filed in response to the Office Action mailed on June 13, 2006. Currently, Claims 14-38, 42-57, 63 and 66-71 are pending in the application. Claims 38 and 49-57 are allowed. Claims 14-21, 23-25, 27-32, 34-37, 42, 43, 45-48, 63, 66, 67 and 69-71 stand rejected. Claims 22, 26, 33, 44 and 68 are objected to. Claims 84-89 are new. Claims 84-89 are the previously canceled Claims 58, 60, 61, 64 and 65; Claim 63 is canceled and rewritten as dependent Claim 85. Applicants respectfully request reconsideration of Claims 14-21, 23-25, 27-32, 34-37, 42, 43, 45-48, 63, 66, 67, 69-71 and 84-89.

#### The Rejection of Claims 14-21, 23-25, 27-32, 34-37, 42-43, 45-48, 63, 66, 67, and 69-71 Under 35 U.S.C. § 102(b)

Claims 14-21, 23-25, 27-32, 34-37, 42-43, 45-48, 63, 66, 67, and 69-71 are rejected under 35 U.S.C. § 102(b) as being anticipated by Grot et al. (WO 96/29752).

For a reference to be anticipatory, the reference must exactly describe the claimed invention.

Claims 14, 24, 31, and 42 each recites having a graft polymer and also recites that the graft polymer is bound to a surface of a pore. At the bottom of page 5, the specification describes plasma graft polymerization can be used in the production of the electrolyte membrane, which involves irradiating a substrate with plasma to generate a reaction start point on the surface of the substrate as well as on the inner surface of the pores of the substrate, and then preferably contacting monomers with the substrate by liquid phase polymerization to graft-polymerize the monomers, both on the surface and in the pores of the substrate. At the top of page 6, the specification describes the plasma treatment step provides the reaction start points on the surfaces of the substrate, including the inner surfaces of the pores. (Page 6, 3rd ¶.) The plasma-treated substrate is then subjected to contact with aqueous solution containing monomers. The porous substrate, having the reaction start points formed thereon, may be immersed in an

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aqueous solution of the monomers. Then, the porous substrate is removed from the aqueous solution after a predetermined time, washed with organic solvents such as toluene or xylene and dried. In this way, by-products produced during the polymerization process, such as homopolymers, can be removed by washing with such organic solvents while the graft polymer may be left on the surface and inner space of the pores in the substrate.

Accordingly, the "graft polymer" in Claims 14, 24, 31, and 42 is grafted to the substrate including the surfaces of the pore.

Grot et al. describes a membrane made by coating the porous substrate with a cation exchange polymer. (Page 9, lines 5-9.) This may be accomplished by impregnating the porous substrate solution/dispersion with the cation exchange polymer or cation exchange polymer precursor using a solvent which is not harmful to the polymer of the support under the impregnation conditions and which can form a thin, even coating of the cation exchange polymer on the support. Accordingly, the coating made from the cation exchange polymer described by Grot et al. is not a graft polymer, as claimed.

Furthermore, Grot et al. does not teach or suggest the claims. A polymer grafted to the porous substrate so that it is chemically bound on the surfaces of the pores gives the claimed electrolyte membrane its advantages. Namely, the advantages are: 1) high proton conductivity is exhibited because of the binding of the graft polymer having high proton conductivity to a surface of the pore, and 2) methanol crossover is reduced, because the polymer which fills the pores cannot be released from the pore. Thus, the pore of the substrate becomes a channel of proton conductivity when the pore is filled with the graft polymer.

Grot et al. does not teach or suggest either advantage. Grot et al. describes the membrane may optionally include a porous substrate for the purpose of improving mechanical properties, for decreasing cost, and/or other reasons. (Page 8, lines 12-14.) Accordingly, Grot et al. does

not teach or suggest the advantages produced by the claimed membrane, namely, the pores of the substrate becoming a channel of proton conductivity. Furthermore, because Grot et al. describes the porous substrate is optional, Grot et al. must also use a non-porous substrate. In the latter case, it is undeniable that the use of the non-porous substrate cannot provide a channel for proton conductivity, which is provided by the porous substrate of the claims.

Claim 66 recites having a porous substrate that consists essentially of an inorganic material selected from the group consisting of ceramics and glass. Grot et al. teaches that the porous substrate is a hydrocarbon such as a polyolefin, e.g., polyethylene, polypropylene, polybutylene, copolymers of those materials, and the like. (Page 8, lines 16-20.) Grot et al. does not teach or suggest the porous support made from ceramics or glass. Grot et al. teaches an inorganic filler that may be essentially nonconductive, such as type A zeolites of cesium, potassium, or mixtures thereof. The inorganic fillers are mixed with a solution/dispersion in a suitable solvent of polymer precursor or with polymer in ionic form and cast as a film. Such solutions can also be used to apply a coating to porous supports to form the membrane. (Page 11, lines 13-19.) Accordingly, if solutions containing inorganic fillers are being coated as films on the porous support, the inorganic fillers can not be the porous supports. Accordingly, Grot et al. does not teach or suggest Claim 66. Additionally, the porous substrate of Claim 66 has the advantage that the it does not swell substantially with organic solvents or water.

For the same reasons discussed above regarding the failure of Grot et al. to describe a graft polymer, Claims 84-89 are submitted to be allowable. Claim 84 is previously Claim 58. Claims 85-87 are previously canceled Claims 63-65. Claims 88 and 89 are previously canceled Claims 60 and 61.

Applicants appreciate that Claims 58, 60, 61, 64 and 65 were rejected in the final Office Action mailed on February 23, 2006. Applicants, therefore, address this rejection below.

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In the final Office Action, Claims 58, 60, 61, 64, and 65 were rejected under 35 U.S.C. § 102(e) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as being obvious over, U.S. Patent No. 6,248,469 (Formato et al.). These claims correspond with new Claims 84, and 86 -89.

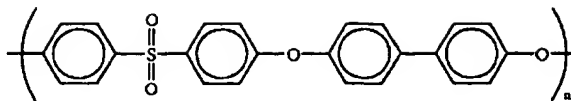
Claims 84 and 88 recite having a graft polymer bound to the surface of a pore.

Formato et al. discloses membranes prepared by the solution casting method as described on pp. 14-15 of the amendment filed on December 23, 2005. Formato et al. teaches that microporous PES films for use in the SPEMs of the present invention can be produced via standard film casting techniques or purchased directly from appropriate vendors. Accordingly, Formato et al. does not teach or suggest graft polymers bound to the surface of a pore, as recited in Claims 84 and 88. The Examiner is respectfully asked to consider the Declaration of Mr. Takeo Yamaguchi stating his qualifications and the performance of experiments demonstrating the differences of the claimed subject matter and the cited reference.

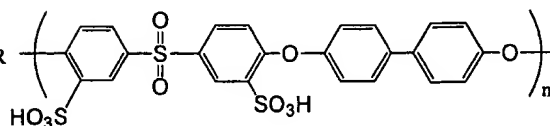
Example 9 (Col. 42, lines 49-60) of Formato et al. discloses SPEM (solid polymer electrolyte membrane) prepared by a solution casting method in which PBO (polybenzoxazole) (see Col. 10, line 13) was used as a porous substrate, sulfonated Radel R<sup>®</sup> polymer (see Col. 23, Table 7) was used as an ion-conducting material, and NMP (N-Methyl-2-pyrrolidone) (see Col. 8, lines 20-21) was used as a solvent for the sulfonated Radel R<sup>®</sup> polymer.

The following chemical structures are of the Radel R<sup>®</sup> polymer disclosed in Formato et al. and of the chemical structure of the sulfonated Radel R<sup>®</sup> polymer.

Polyphenylsulfone (Radel R®)

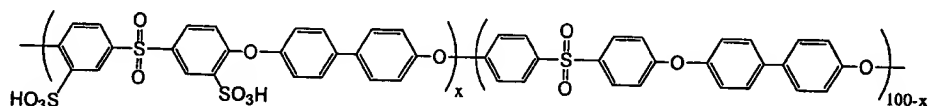


Sulfonated Radel R



The sulfonated Radel R® polymer used in Example 9 of Formato et al. has a chemical structure that is the same as the SPES polymer described in the declaration of T. Yamaguchi attached herewith, which is also depicted below.

SPES Polymer



In accordance with the declaration of T. Yamaguchi, pre-synthesized SPES polymer was dissolved in an organic solvent. The above porous polyimide substrate was immersed in the resulting solution so that the SPES polymer filled the pores of the porous polyimide substrate. The resulting membrane was used for leaching experiments using water, a water-MeOH solvent mixture and N-methylpyrrolidone. N-methylpyrrolidone, water and water-MeOH mixed solvent are good solvents for the SPES polymer. N-methylpyrrolidone is also good solvent for the sulfonated Radel R® polymer, as described in Example 9 of Formato et al. The results of the leaching experiment are presented in Table 1 of the declaration.

Taking the above statements and declaration into consideration, if the SPEM of Example 9 of Formato et al. is immersed in N-methylpyrrolidone (a good solvent for the sulfonated Radel R® polymer), the sulfonated Radel R® polymer will be leached out.

On the other hand, in accordance with Experiment B of the declaration filed on December 22, 2005, polymers according to the present invention were not leached out, since the polymer, in particular, one end of each of polymers is chemically bound to surface of pores of the membrane.

Comparing the above two paragraphs, the "interpenetrated" ion-conducting material described in Formato et al. is leached out, while the "chemically bound" proton conductive, graft polymer according to the present invention is not leached out. Therefore, Formato et al. does not inherently disclose the present invention nor does Formato et al. suggest the present invention.

Accordingly, applicants submit that has novelty and unobviousness over Formato et al. and Grot et al.

#### New Claims 84-89

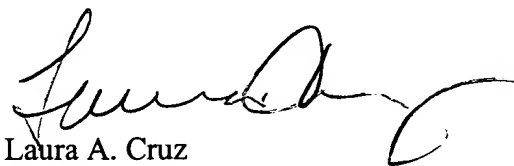
Claims 84-89 are new. Claim 84 is previously canceled Claim 58. Claim 85 is the canceled Claim 63 rewritten in dependent form. Claims 86 and 87 are, respectively, previously canceled Claims 64 and 65. Claims 88 and 89 are, respectively, previously canceled Claims 60 and 61.

CONCLUSION

In view of the foregoing, applicants respectfully submit that the claims are in condition for allowance. If the Examiner has any further questions or comments, the Examiner may contact the applicants' attorney at the number provided below.

Respectfully submitted,

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